REMARKS

Applicants have amended their specification at page 25 in order to refer to the proper drawing figure. Noting that the paragraph bridging pages 25 and 26 of Applicants' specification refers to "Figure 7"; that there is no Fig. 3(d); and that Fig. 7(d) includes reference character "303", it is respectfully submitted that one of ordinary skill in the art as of the filing date of the above-identified application would have known that the reference to a figure in line 25 on page 25 should be to "Figure 7(d)", and that, accordingly, the present amendment at line 25 of page 25 does not constitute new matter.

Furthermore, noting original claim 1 in the above-identified application, and, also, original claim 29 of prior Application No. 09/646,012, as well as the amended Abstract thereof, it is respectfully submitted that the amendment to the paragraph at page 14, lines 3-16, of Applicants' specification, does not constitute new matter.

Applicants have amended their claims in order to further clarify, and to further define, various aspects of the present invention. Specifically, Applicants have incorporated the subject matter of claim 4 into claim 1, and have deleted from claim 1 recitation of a frequency range for the radio frequency bias voltage applied on the sample board. In light of amendments to claim 1, claims 2-4 have been cancelled without prejudice or disclaimer, and dependency of claim 5 has been amended. In addition, claim 6 has been amended to recite that the "sample to be treated" is a lamination of at least metal of tungsten film and semiconductor of polycrystalline silicon film.

In addition to amendments to previously considered claims, Applicants are adding new claims 9-22 to the application. Of these newly added claims,

which are all directed to a surface processing method, claims 13, 21, and 22 are independent claims.

Claim 9, dependent on claim 1, recites that the method is divided into steps, with the net power of the radio frequency power applied to the sample being reduced at least in the last step (note the Second Embodiment starting on page 22 of Applicants' specification); and claim 10, also dependent on claim 1, recites the frequency for cyclic on-off control of the radio frequency voltage (note, for example, page 20, lines 5-7, of Applicants' specification). Claims 11 and 12, each dependent on claim 1, respectively recites the percentage of on-period of the radio frequency voltage (note the paragraph bridging pages 19 and 20, and the paragraph bridging pages 27 and 28, of Applicants' specification); and recites a frequency for the radio frequency bias voltage applied, consistent with that in original claim 1 (which has now been deleted from claim 1).

Claim 13 defines a surface processing method using a mask layer without containing carbon, wherein a sample (with the mask layer) is laid on a sample board in a vacuum container, plasma is generated inside the vacuum container, radio frequency bias voltage is applied on the sample board and plasma treatment is provided by periodic on/off control of radio frequency bias voltage, with the plasma consisting of a mixture of halogen gas and adhesive gas, the halogen gas being a mixed gas of chlorine and BCl_3. Note, for example, claim 12 of U.S. Patent No. 6,660,647, which issued from a prior application of the above-identified application being relied upon under 35 U.S.C. §120. Claims 14 and 15, dependent respectively on claims 13 and 14, respectively recites that the adhesive gas is a carbon hydride and further

defines this carbon hydride. Claims 16 and 17, dependent respectively on claims 13 and 16, respectively defines the adhesive gas in terms of how it is prepared; and further defines the carbon hydride of the adhesive gas and the noble gas of the adhesive gas. Claims 18-20, each dependent on claim 13, respectively recites that the adhesive gas is nitrogen gas or gas including nitrogen atom; further defines the method of making intermittent the bias voltage applied to the sample, in terms of the percentage of on/period; and recites the mixing rate of the adhesive gas with the halogen gas.

New independent claim 21 defines a surface processing method for a sample including a multilayer film of n-type and p-type polycrystalline silicon laminated on an oxide film, including, inter alia, treating the sample by a plasma generated inside a vacuum container in which the sample is installed on a sample board, this treating including etching, and wherein the etching includes etching the n-type and p-type polycrystalline silicon by introducing mixed gas including fluorine and oxygen into the vacuum container while applying periodically on/off controlled radio frequency bias voltage, with continuous etching being performed after exposing of the oxide film by changing the etching gas into a mixed gas containing hydrogen bromide and oxygen, and changing the radio frequency voltage into continuous application. Note, for example, the Third Embodiment on pages 25-28 of Applicants' specification.

New independent claim 22 defines a surface processing method of a sample having a multilayer film of polycrystalline silicon laminated on an oxide film and metal film laminated on the polycrystalline silicon film, including, inter alia, treating the sample by a plasma generated inside a vacuum container in

which the sample is installed on a sample board, this treating including etching, with the etching including etching the metal film by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying the radio frequency bias folders continuously, and etching the polycrystalline silicon by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying periodically on/off controlled radio frequency bias folder, and after exposing of the oxide film, continuously etching by changing the etching gas into mixed gas containing hydrogen bromide and oxygen and changing the radio frequency voltage into continuous application. See, for example, the Fourth Embodiment on pages 28-30 of Applicants' specification.

The objections to claims 2 and 4 on page 2 of the Office Action mailed May 12, 2005, are noted. Insofar as the subject matter of claim 4 has been incorporated into claim 2, the period "." after the word "consisting" in claim 4 has been omitted from the subject matter incorporated into claim 1; and, moreover, of the subject matter from claim 4 incorporated in claim 1, it is recited that the mixed gas includes a "gas" containing oxygen atom . Moreover, as set forth previously, claim 2 has been cancelled without prejudice or disclaimer. Accordingly, it is respectfully submitted that the claim objections set forth on page 2 of the Office Action mailed May 12, 2005, are moot.

The obviousness-type double patenting rejection of claim 1, over claim 1 of U.S. Patent No. 6,660,647 in view of Mikagi (U.S. Patent No. 6,274,932), set forth on pages 2 and 3 of the Office Action mailed May 12, 2005, is noted. In view of the incorporation of subject matter of claim 4 into

claim 1, in the present application, it is respectfully submitted that the obviousness-type double patenting rejection is moot.

Attention is directed to all of the newly added claims in the above-identified application. It is respectfully submitted that such claims define a separate patentable invention from the subject matter of claims 1-14 of No. 6,660,647 (and that, accordingly, it is respectfully submitted that the subject matter of these claims are free of any obviousness-type double patenting in view of the subject matter claimed in No. 6,660,647.)

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims under 35 U.S.C. §103 in the Office Action mailed May 12, 2005, that is, the teachings of the U.S. Patents to Kubota, et al, No. 5,928,528, to Mihara, No. 6,020,111, and to Yokoyama, et al, No. 5,515,984, under the provisions of 35 U.S.C. §103.

Initially, attention is respectfully directed to the indication by the Examiner of allowable subject matter, set forth in Item 6 on page 5 of the Office Action mailed May 12, 2005. Note the Statement of Reasons for Indication of Allowable Subject Matter, in the last paragraph on page 5 of the this Office Action mailed May 12, 2005, wherein the Examiner indicated that the prior art of record fails to disclose a surface treatment method including the step of using a mixed gas consisting of at least the gas containing fluorine atom and the gas containing oxygen atom, in combination with the rest of the limitations of claim 4. In view of incorporation of subject matter of claim 4 into claim 1, it is respectfully submitted that claim 1, and claims dependent thereon, would be allowable.

In addition, note that claim 21 recites that the n-type polycrystalline silicon and the p-type polycrystalline silicon are etched by introducing a mixed gas containing fluorine and oxygen into the vacuum container while applying periodically on/off controlled radio frequency bias voltage; and claim 22 recites that the metal film is etched by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying the radio frequency bias voltage continuously, among other processing steps recited in claims 21 and 22. In view thereof, it is respectfully submitted that claims 21 and 22 should also be allowed, in view of e.g., the gas used in etching various materials in claims 21 and 22.

In any event, it is respectfully submitted that the references as applied by the Examiner in the Office Action mailed May 12, 2005, would have neither taught nor would have suggested such a surface processing method as in the present claims, wherein a sample where a mask layer without containing carbon as a main component is formed on the substance to be processed is laid on a sample board in a vacuum chamber and a plasma is generated, with radio frequency bias voltage applied on the sample board and plasma treatment being provided by periodic on/off control of radio frequency bias voltage applied on the sample board, and with the plasma consisting of a mixture of halogen gas and adhesive and the halogen gas being a mixed gas of chlorine and BCl_3. See claim 13.

Furthermore, it is respectfully submitted that these references would have neither taught nor would have suggested such a surface processing method of a sample including multilayer film of n-type polycrystalline silicon and p-type polycrystalline silicon laminated on an oxide film, including, inter

alia, applying a radio frequency bias voltage on a sample board upon which a sample is installed in a vacuum container, with a plasma of a gas being generated inside the vacuum chamber; and treating the sample by the plasma, with this treating including etching, the etching including etching of the n-type and p-type polycrystalline silicon by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying periodically on/off controlled radio frequency bias voltage, and after exposing of the oxide film (e.g., through etching of the polycrystalline silicon), continuously etching by changing the etching gas into mixed gas containing hydrogen bromide and oxygen, with continuous application of radio frequency voltage. See claim 21.

Moreover, it is respectfully submitted that these applied references would have neither disclosed nor would have suggested such a surface processing method of a sample comprising multilayer film of polycrystalline silicon laminated on an oxide film and metal film laminated on the polycrystalline silicon film, including, inter alia, applying a radio frequency bias voltage on a sample board upon which a sample is installed in a vacuum container, with generation of a plasma inside the vacuum container, and treating the sample by the plasma, with this treating including etching, the etching including etching of the metal film by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying radio frequency voltage continuously, and etching the polycrystalline silicon by introducing mixed gas containing fluorine and oxygen into the vacuum container while applying periodically on/off control radio frequency bias voltage, continuous etching being performed after exposing of the oxide film by changing the

etching gas into mixed gas containing hydrogen bromide and oxygen and continuously applying the radio frequency voltage. See claim 22.

Furthermore, it is respectfully submitted that the teachings of the applied prior art would have neither disclosed nor would have suggested such a surface processing method as in the present claims, including features as discussed previously in connection with, e.g., claims 1 and 13, and having additional features as in the dependent claims, such as features in claims 5-12 and 14-20.

According to features of the present invention, including the off/period of the radio frequency bias voltage applied on the sample board, the number of high energy ions are reduced, and hence reduction of selectivity can be avoided.

The processing according to the present invention allows a flat etched surface to be formed without irregularities remaining on the etched surface, and permits the multilayer film to be etched without disadvantageously large etching of the underlying oxide film. The present processing permits both p-type polycrystalline silicon and n-type polycrystalline silicon to be etched at substantially the same processing rate, without etching through an oxide film underlying the polycrystalline silicon. Moreover, through use of the mask which does not contain carbon as a major component, reduction in selectivity between the material of the overlying film and oxide film, due to carbon in the resist which accelerates oxide film etching, can be avoided.

Kubota, et al discloses a plasma treatment method and system using a high-frequency discharge, the method including steps of putting a reactive gas supplied to a vacuum chamber into plasma by supplying radio frequency

power to a vacuum chamber intermittently or while repeating high and low levels alternately, and working a specimen in the vacuum chamber by the plasma, wherein a positive pulse-like bias voltage synchronized with a period in which the radio frequency power is not supplied or a period in which low-level is supplied, is applied to the specimen. See column 3, lines 16-26. Note also column 4, lines 15-20; column 6, lines 45-53; column 7, lines 32-36; and column 8, line 63 to column 9, line 6.

It is respectfully submitted that Kubota, et al would have neither taught nor would have suggested features of the present invention including the etching gas used in, e.g., claims 21 and 22. Moreover, it is respectfully submitted that Kubota, et al would have neither taught nor would have suggested the specific structure processed by the etching, and the different etching processing including periodically on/off controlled radio frequency bias voltage and continuous application of radio frequency voltage for different parts of the structure etched, and advantages of this processing.

Furthermore, it is respectfully submitted that this reference would have neither taught nor would have suggested the processing as in claim 13, including the mixture of gases of which the plasma consists, and advantages thereof as discussed in Applicants' specification and referred to previously.

It is respectfully submitted that the secondary references applied by the Examiner would not have rectified the deficiencies of Kubota, et al such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art.

Mihara discloses a method of manufacturing a semiconductor device, including a process of patterning a lamination of a silicon film and a metal film

formed thereon, the method being described most generally in column 1, line 53 to column 2, line 3. This method includes forming a resist film on a laminate wherein the first film is silicon; and before the step of patterning the first film, heating the resist pattern to a specified temperature to remove the resist pattern. Note also column 2, lines 7-10; column 3, lines 38-51; and column 5, line 66 through column 6, line 3.

Even assuming, arguendo, that the teachings of Mihara were properly combinable with the teachings of Kubota, et al, such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including the plasma, especially together with application of the radio frequency power, and advantages thereof as in the present disclosure; and/or gas used in forming the plasma.

Yokoyama, et al, discloses a method for etching an electrode material for a capacitor using a ferroelectric, particularly to a method for etching a platinum film. The method is described most generally in column 2, lines 3-16, and includes, after etching the platinum film by using an etching mask, whereby layers made of $PtCl_xO_y$ or a mixture containing $PtCl_x$ and PtO_y are formed on side walls of the etching mask (etching resistant film) and the Pt film, and these layers are removed with an acid by wet etching after the etching step. This patent discloses use of a mixed gas of oxygen gas and chlorine gas or chloride gas, for etching the Pt film.

Noting in particular that Yokoyama, et al, is directed to etching a platinum film, it is respectfully submitted that one of ordinary skill in the art concerned with in Kubota, et al, would not have looked to the teaching of

Yokoyama, et al. It is respectfully submitted that there would have been no motivation for combining the teachings of Kubota, et al, and Yokoyama, et al.

In any event, even assuming, arguendo, that the teachings of Yokoyama, et al, were properly combinable with the teachings of Kubota, et al, and Mihara, such combined teachings would have neither disclosed nor would have suggested the surface processing method according to the present invention, including the gas used in the plasma treatment (e.g., etching treatment); and/or laminate structure processed, and advantages achieved by the present invention,

In view of the foregoing comments and amendments, reconsideration and allowance of all claims presently in the application are respectfully requested.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (Case No. 520.38979CX1) and please credit any excess fees to such deposit account.

Respectfully submitted,

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Attachments